FJS:AER

DEPARTMENT OF COMMERCE

BUREAU OF STANDARDS

WASHINGTON

March 17, 1919

ADDRESS REPLY TO
BUREAU OF STANDARDS

Confidential Bulletin 23

1. Carburetion Studies

An investigation was made of the altitude compensation of the Stewart-Warner Liberty Carbureter, which resulted in a setting affording very satisfactory altitude compensation without mechanical moving parts. The Zenith carbureter has been given study with respect to performance under the condition of pulsating air flow, by the aid of the newly developed device for simulating in a carbureter test plant, the pulsating flow characteristics of actual engine practice.

2. Aeronautical Radiators

Heat tests were run on three new specimens of honeycomb radiator similar to the British Standard Type.

3. Various Engine Problems

By the use of the single cylinder Liberty engine, the Bureau has arranged to measure the temperature of oil films during engine operation; to measure the temperature of moving parts of the engine as the piston, wrist pin bearings, etc.; the velocity of flame propagation; and the apparent temperature within the cylinder. Only preliminary measurements of these quantities have been secured at this time, but sufficient data have been obtained to demonstrate the satisfactory operation of all the apparatus involved.

A series of measurements ~~have~~ had been made of fuel consumption in a Ford engine with different adjustments of stock carbureters, to illustrate the possibilities with respect to fuel saving in ordinary practice.

4. Aeronautic Instruments

The Bureau has prepared, in cooperation with the National Advisory Committee for Aeronautics, an exhibit of aeronautic instruments for the Aeronautical Exposition in New York City, including samples of diaphragms spun at the Bureau; a chain testing device in operation; a whirling table demonstration showing different types of banking indicators; the interior parts of some typical instruments; a group of tachometers driven by a single motor, the cases being opened to show the mechanism in action; various other aeronautical instruments including some captured enemy instruments; statistical charts showing pictorially the results of tests on air speed indicators, and photographs of the various pieces of testing equipment at the Bureau.

A design has been completed for an open scale altimeter which is to be an instrument of high precision for use in performance tests of aircraft and in field laboratories where it may take the place of the mercurial barometer. The fundamental principle of the present design is the combination of a very stiff mainspring with a very flexible diaphragm,

thus avoiding to the greatest extent the difficulties arising from deficient elastic properties of diaphragm materials. A study has been made of the rather serious secular changes in the Veeder master tachometer.

5. Machine Gun Synchronizing Gears

An improved electro-mechanical synchronizing control gear for machine guns on airplanes has been developed in cooperation with the Division of Military Aeronautics and the General Staff (Inventions Section), and demonstrations of its operation with the Browning gun have recently been given for a number of army officers. Targets representing the airplane propeller and the circular field which it covers have been photographed after the firing of bursts through them. The control effectually synchronizes the gun when traversed at an angle with the axis of the plane, and the General Staff has requested the Bureau to construct a modification of the apparatus which will permit the gun to be elevated or depressed as well as traversed.

Accordingly a new mounting has been designed, and considerable progress has been made on the design of the apparatus to shift the time of firing so as to miss the propeller blades when the line of fire is changed to any angle with respect to the axis of the propeller. The apparatus will also prevent firing in any prescribed direction where there would be danger of hitting fixed parts of the plane structure.

6. Airplane Landing Signals

The work on electrical induction signals to assist aviators in locating landing places has been continued in cooperation with the Navy and Post Office Departments. A large transmitting coil has been installed at College Park and a 5-turn receiving coil has been installed on each wing of the airplane used for experimental work. Trials under service conditions will shortly be made.

7. Fog Signalling

Some years ago the radio direction finder, which has since found very extensive use, was developed at the Bureau with particular reference to fog signalling. On account of the importance of this device to the Navy, its development for commercial use was deferred during the war. Its application is now being actively considered and a cooperative program for the Bureau of Lighthouses, the Navy Department, and the Bureau of Standards has been arranged.

8. Vacuum Tubes

Among the experimental developments in connection with the vacuum tube investigation has been the use of the low-frequency oscillograph in measurements of electron currents at audible frequencies. Work has been done on the comparative emission of tungsten filament and oxide-coated filament tubes, and a method has been developed for

taking reliable characteristic curves of oxide tubes. The comparison of three types of high power tubes has been begun at the request of the Navy Department to assist the Navy in the determination of a suitable type for power purposes. The regular testing of vacuum tubes for the Signal Corps has been completed and a research begun on detecting tubes to the end of learning more thoroughly the mechanism of the detecting action.

9. Precision Measurements at Radio Frequencies

A shield has been constructed to be placed over any coil used in the measuring circuit of the apparatus for measuring phase differences, making possible the establishment of a definite and reproducible potential at all points of the measuring circuit. An apparatus for production of large currents for testing ammeters has been set up and put into use.

10. Sound Ranging Apparatus

Work has been continued on an apparatus designed to record the earth shock from a gun, special attention being given to the further development of amplifiers. The results of this investigation are negative and the Bureau has advised the War Department that further attempts to record gun positions by earth shocks are not likely to be fruitful.

11. Wire Communication

In the telephone section, studies are being made of automatic and automanual machine switching and of telephone transmission testing as well as the mathematical theory of transmission. At the request of the State Department, a study is being made of the status of submarine cable manufacture and related problems in the theory of cable transmission and cable signalling. The Bureau will cooperate with the Telephone and Telegraph Administration in the investigation of methods of transmission of telegrams, to the end of choosing the most economical methods for land lines. In this connection a study is being made of the application of automatic switching methods to telegraphy.

12. Dry Cells and Storage Batteries

Special apparatus for making tests of dry cells under conditions simulating their performance in practice has been developed and constructed in preliminary form. Experiments have been begun on the corrosion of zinc in solutions of ammonium chloride, and on the conductivity of samples of manganese ore. The design and construction of disc dry cells is being given special study and several batteries of this type have been completed and put on test under conditions permitting the continuous observation of the individual elements in the battery. Specifications for dry cells, prepared by the Bureau, have been adopted by the War Department practically without change. The Committee in

charge of the matter also adopted the specifications for storage batteries for industrial trucks and tractors, prepared jointly by the Construction Division of the War Department, the Engineers' Committee of the Manufacturers' Association, and the Bureau of Standards. The publication of the circular on dry cells previously mentioned has been delayed pending the action of the War Department on the proposed specifications. The circular is now being printed and will soon be ready for distribution.

13. X-Rays in Inspection Materials

At the request of the Bureau of Aircraft Production, further studies have been made of the possibility of using X-rays to locate pitch spots or other lack of uniformity in samples of wood. Pieces of shell have been submitted to determine the possibility of using X-rays to locate internal flaws in shell. The material, ~~The~~ the results are not encouraging as the X-rays are not sufficiently penetrating for materials of the thickness involved, while gamma rays are so penetrating that only large flaws are detected.

14. Measurement of Radium

The amount of radium received for measurement during the month of January greatly exceeded that of any month since the beginning of this work: 87 specimens totalling 1745 mg of radium, valued at $209,400 were received.

15. Conference on Industrial Safety Codes

This conference was attended by about 100 representatives of engineering and utility organizations, state commissions, city departments, manufacturers' associations, insurance companies, Federal bureaus, and labor organizations. The general opinion was that the Bureau of Standards should undertake the formulation of a series of National Industrial Safety Codes. On the day following the conference, groups of delegates met with the Bureau's representatives to consider proposed rules for the Electrical Safety Code, the Elevator Code, the Code for Head and Eye Protection, and the Code for Guarding Machine Drives.

16. Metallographic Tests

Metallographic tests conducted for the Ordnance Department of the Army included: examination of rifle barrels to show general nature of steel; examination of copper rotating bands to show deformation produced by rifling; samples of semi-steel shells; tension bars; sample rings from German guns; for the U. S. Shipping Board, examination of ten inch propeller shaft which failed in service. Tests for civil agencies included: deterioration of nickel spark plug wires; failed wrought iron bridge member; nichrome tubes deteriorated in service; malleable castings presenting difficulties in machining.

17. New Method for Thermal Analysis

The usual practice in recording inverse rate heating and cooling curves in thermal analysis is to record with a chronograph the consecutive time intervals. This involves the use of a relatively expensive apparatus, now difficult to obtain. It is also necessary in this method to count the time intervals from the chronograph sheet, a process requiring one or two hours. It has been found that these time intervals could be recorded as accurately and almost as conveniently by two stop watches, which thus serve as cheap substitutes for a chronograph. By this process much time is conserved.

18. Moulding Sand Investigation

The Naval Gun Factory reports that it is possible to use successfully a sand mixture containing 43% of the sand recovered by the method developed in the laboratory of this Bureau. A method has been devised for determining the optimum water content of moulding sands, consisting in adding an excess of water and whirling the mixture in a centrifuge, a procedure which, if adopted generally, will greatly speed up the preparation of moulds in the foundry.

19. Enameling Cast Iron Ware

A paper covering the principles and practice of manufacturing enameled cast iron ware is now in press. This, when issued, will be the first comprehensive treatment on this subject ever published. The sources, methods of preparation, and properties and effect of raw materials used in white enamels for cast iron will be discussed. Methods of calculating enamel formulas and examples of enamel compositions of various types are given. The defects in enamels, their causes and remedies, are discussed from both the theoretical and practical standpoints. Manufacturing methods and equipment used in compounding and applying the enamels and in making and preparing the castings are described.

20. Standardization of Pressure Plugs

On February 14, representatives of the Ordnance Department of the Army, and of cartridge manufacturers met at the Bureau to discuss methods of pressure testing of ammunition and the standardization of the copper plug method of pressure determination in small arms. The specifications prepared by the Bureau were discussed and formally recommended for adoption. These included specifications for copper rods to be used in the preparation of the gage cylinder, and for the methods of calibration and pre-compression of the copper cylinders.

21. Metallurgical Information

Information furnished by correspondence has included the following subjects: zirconium steels; heat treatment of instrument diaphragms; tests of china and porcelain ware; porosity in metals; properties of sheet zinc; deterioration of coatings on copper wire; tests for sharpness of edged tools; effect of temperature on strength of bronzes;

sources of invar; stainless steel; annealing of phosphor bronze wire; alloying and refining of gold and platinum; characteristics of high speed steels; tin-lead alloys for coating copper; acid-proof iron alloys; transformation point recorders; substitution of aluminum alloys for instrument brass.

22. Transparent Fabrics

The Bureau has carried on an investigation at the request of the aviation authorities with respect to a transparent fabric, and has succeeded in developing a satisfactory material of this character which will serve for wind shields and windows, as well as for the wing surfaces of planes. The Division of Military Aeronautics is cooperating with this Bureau in the preparation of specifications.

23. Conference on Paint Specifications

This conference, looking to the unification and coordination of paint specifications for all government purchasing agencies, was held on February 26 at the Bureau of Standards. Representatives attended from the War, Navy, Interior, Treasury, Agriculture, and Post Office Departments, and from the Housing Corporation, and the Panama Canal. The preparation of certain uniform standard specifications will be initiated and a committee for this purpose was appointed with a tentative personnel consisting of one representative each from the War, Navy, Interior, Treasury, Agriculture, and Post Office Departments, the Housing Corporation, Panama Canal, U. S. Railroad Administration, and the Bureau of Standards, and one from the paint and varnish industry.

24. Protective Coatings

In cooperation with the National Advisory Committee for Aeronautics, a series of tests is planned on the corrosion resisting properties of light alloys to which various protective coatings have been applied. The coating having been applied, the sheets will be affixed to frames and sent to chosen stations for exposure. Tests have been made, at the request of the Navy Department, to determine the relative impermeability to water of various airplane wing enamels and varnishes. The Bureau has prepared a circular letter on the "Protection of Metals in Storage", containing information which has been complied in response to numerous inquiries received on this subject. At the request of the Ordnance Department of the Army, a study was made of the thickness of two types of paint films on shell in relation to the tolerances allowable on the diameter of such a shell.

25. Gas Investigations

In cooperation with the Chemical Warfare Service, a preliminary report has been made on the preparation and purification of methane. Studies have been made and papers are in preparation on the oxygen content of balloon gases in service.

26. Electroplating Investigation

During the past month, a considerable number of tests were carried on at the request of the Ordnance Department on lead plating in order to determine the results following the use of certain addition agents in lead acetate and fluoborate solutions, a question of importance in connection with certain patent claims relating to lead plating processes.

27. Miscellaneous Chemical Materials

Flying tests were made on anti-freezing solutions for airplane radiators to determine the rate of loss of alcohol and water from a solution of 20% alcohol, 20% glycerine, and 60% water (by volume), to the end of permitting empirical correction or adjustment of the solutions avoiding chemical analysis, if possible. The glycerine content is for the purpose of raising the boiling point to meet the conditions of high altitude flight.

Tests were made for the Motor Transport Corps of a sample of rust preventive of the slushing oil type, which was found to be exceptionally faulty in its tendency to leave bare spots on polished metal. Work is being done on a waterproofing composition for use on paper containers. A specification covering creosote oils was prepared for the Construction Division of the Army, and a great many tests of such oils have been made at the Bureau.

28. Airplane Wing Beams

Twelve 8-foot laminated airplane wing beams submitted by the Naval Aircraft Factory were tested in cross bend on third point loading. The results showed that the modulus of rupture was below that generally developed in spruce, on account of the fact that the maximum flexural stresses were not developed, the failure being due to horizontal shear.

29. Strength Tests of Various Equipment

Two samples of galvanized stranded steel wire for use on naval aircraft were examined to determine whether the presence of certain markings on the galvanizing affected the usefulness of the wires. It was indicated that the protection of the wires is diminished by the markings, although their nature could not be determined. Numerous specimens of semi-steel fragments were tested in compression, tension, and bending, and for hardness. Impact tests were made on 3 parachute rings which were subjected to 1000 to 1100 ft-lb. impact energy. One hollow cast steel motor truck wheel was subjected to tests in radial compression and side thrust. The maximum load applied in radial compression was 60,000 lb. and the breaking load in side thrust was 39,300 lb. A 3" wire cable was tested in tension, failing at 941,000 lb.

30. Munitions Gages — During the month of February, 1598 profile, thread, and plain gages were received for test at the Washington, New York, and Cleveland gage laboratories of the Bureau.

Informal publications have been prepared on the following subjects: "The Determination of the Clearance of Thread Gages by the Lantern"; "Formula for Determining Effective Diameter of Buttress Type Threads"; "Important European Screw Thread Systems"; "Explanation of Drawings Used in Manufacture of Lead Testing Devices".

31. Interference Measurements of Precision Gages — 900 precision gages manufactured at the Bureau by a new process developed by an officer of the Ordnance Department, were tested for length and flatness, and parallelism of surface; 40 Swedish-made precision end standards were also calibrated by interference methods.

32. Testing of Natural Gas Meters — At the request of the U. S. Fuel Administration, the Bureau tested 103 large natural gas meters, in the interest of the conservation of natural gas. These meters were used to measure the natural gas supplied to various cities and towns in Kansas and Missouri in order to determine the amount of leakage in the distributing system of these places. About $7,500,000 worth of natural gas is measured per year through these meters, and their registrations in comparison with those on the consumer's premises have shown that about 40% of the gas delivered, or about $3,000,000 worth, is lost annually by leakage.

33. Weights and Measures Inspection — A recently appointed state inspector of weights and measures spent a portion of several days at the Bureau visiting the weights and measures laboratories and discussing with members of the staff, matters relating to the testing and inspection of weights and measures and of weighing and measuring devices. The Bureau has cooperated in a similar way with a number of the Navy Yards and munition plants and has, in several instances, outlined the complete requirements for the inspection, for example, of weighing scales and the maintenance of proper weight standards in such establishments.

34. Spectroscopic Investigations — The tests of photographic dyes and the work on the hypersensitizing of photographic plates have been continued. 2 samples of dicyanin have been prepared by the Bureau of Chemistry, which proved to be equal to the German product for sensitizing photographic plates to the infra-red. It is believed that this is the first time this dye has been made outside of Germany. Investigations respecting the effect of ammonia in increasing the speed of panchromatic plates have included photometric measurements of the photographic actions in various parts of the spectrum; 20 electrical discharge tubes of various types were filled with helium to serve as light sources in optical testing.

35. Colorimetric Work

Problems considered by the colorimetric section during the past month included: the distribution of luminous flux about the bare arc of a searchlight; the determination of the scattered light in a searchlight beam; diffuse reflection of painted card board (for the Navy Department); spectral and total transmission of 2 glasses; color grading of flares (for the Ordnance Department, U. S. Army); measurement of quality of glazed pottery surface; measurement of sky brightness and polarization; specification of the opacity and color of paper; ultra-violet transmission of magnesium oxide; photometry of colored lights and railway signal glasses, and color charts.

36. Optical Instruments

Routine tests of binoculars have slightly decreased in number with the closing of military contracts. 61 were tested during the month of February for the Signal Corps, and 24 for the U. S. Shipping Board. 14 pairs of aviators' goggles were tested for the Navy Department. The specifications on goggles used by the Norfolk Navy Yard were studied and a number of changes recommended. In cooperation with the Ordnance Department of the Army, a preliminary investigation is being made of the cause of deterioration of the reticules of telescopes. An examination was made of the optical system as well as the practical operation of a motion picture projection lantern providing for continuous movement of the film. Tests were made to determine the focal length of a spherical concave mirror and the speed of a focal plane shutter for a camera. Consultation was afforded with respect to an optical means of registration for tests of draw-bar and car buffer action in railway train operation. The Bureau is developing a routine for the rapid testing of camera lenses at low cost, so that commercial firms or individuals may be able to secure a test and certificate of performance of their camera lenses at a price of $2.00 or less. Resolution charts for the purpose have been prepared.

37. Design of Polariscopes

Advice and assistance were given American manufacturers of optical apparatus on the production of a polariscope for sugar testing. A critical examination was made of the optical parts thus far produced and the necessary requirements and improvements pointed out. The production of an American-made saccharimeter is a matter of great importance, as the large number of instruments now in use were all imported and have in the past been made almost exclusively in Germany.

38. Radiometric Work

An investigation has been completed on the photo-electric sensitivity of silver sulphide and several other substances, and a paper on the work is now in course of preparation. The eye protective properties of several spectacle glasses and the reflecting power of a stellite mirror were determined and reported on.

39. Cement, Concrete, and Stone Investigations

During the past month, a series of tests of atomizer specimens from the Brown atomizer and the cement gun, at the age of four months, were completed. Strength as high as 4,000 lb. per sq. in. was obtained on 1:3 mixtures. There was completed also a series of permeability tests on samples of gunite.

In order to determine definitely whether or not there is an actual permanent increase in the dimensions of marble specimens subjected to alternate heating and cooling, a question of considerable importance in building construction, three slabs of marble approximately 6 feet long have been prepared for accurate measurements of the linear dimensions under exposure to weather conditions on the roof of one of the buildings of the Bureau. This relates to an investigation of the marble floor around the colonnade of the amphitheatre at Arlington, in determining the cause of the cracking in this floor.

The Bureau has begun the preparation of standard cement samples to be used in the standardization of 200 mesh sieves, which will contain 180 grams, enough for three tests, and will sell for 25¢. They should be available in about 60 days. Test has been conducted on a sieving machine manufactured for laboratory use in making fineness determinations. The machine did not prove satisfactory for this purpose.

A diatomaceous earth, known as "Celite", was used in a mixture of 1:2/3:1/3 sand-gravel concrete to determine the effect of such addition on the strength and absorption. Celite was added to the cement, sand, and gravel in the proportion 0%, 5%, and 10% by weight of cement. Results of 7 day tests show a decrease of about 50% due to the addition of 5% Celite and about 60% due to the addition of 10% Celite. A mix in which the Celite and cement were blended before mixing the concrete proved slightly stronger than the one in which 10% was added to the mixture of cement, sand, and gravel.

A method, which has been tried out for determining the specific gravity of finely powdered materials, promises to obviate the difficulties previously experienced in making density tests of such materials resulting from the clinging of air to the particles.

Inspections were made by representatives of the Bureau, of the roof of a government building in Washington which was poured in cold weather and of which the concrete had not properly hardened. Studies are being made to determine whether the material can safely care for the loads to which

it will be subjected after the removal of the forms. Specimens of concrete being used at the Norfolk Navy Yard were tested upon request to determine the suitability of the constituent materials, and samples of sand submitted by the Engineer Corps were tested for quality. Sieving analyses were made on a sample of antimony tri-sulphide and standard sieving tests were made on 26 200-mesh sieves submitted by the manufacturer.

40. Lime Investigations

Probably the most serious defect in a lime plaster is that known as "popping". Small particles of the plaster expand to such an extent that they finally push themselves out of the wall, leaving "pin-holes", or "pops". A study is being made to determine whether this is due to the presence of over-burned lime, under-burned lime, improperly hydrated lime, or unclean sand. Specimens are being made containing each of the above variables in a pre-determined degree.

A study is being made of the working qualities of lime plaster applied under competent supervision, to coordinate, if possible, the results of practical application with the laboratory determinations by means of the plasticimeter.

41. Sand-Lime Brick Investigations

Laboratory results on small specimens indicate that it is useless to cure sand-lime brick for more than four hours; whereas the usual curing period is seven to twelve hours. Five manufacturers of sand-lime brick have agreed to vary the time of curing their brick under the supervision of the Bureau, and send in samples for physical tests.

A member of the staff presented a paper on the effect of the size of the sand grains on the compressive strength and absorption of sand-lime brick, at the annual meeting of the association of that industry.

Respectfully,

S. W. STRATTON

Director
FJS